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IS 9000-11 (1983): Basic environmental testing procedures for electronic and electrical items, Part 11: Salt mist test [LITD 1: Environmental Testing Procedure]



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IS : 9000 (Part XI) - 1983

Indian Standard

BASIC ENVIRONMENTAL TESTING
PROCEDURES FOR ELECTRONIC AND
ELECTRICAL ITEMS

PART XI SALT MIST TEST

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BUREAU OF INDIAN STANDARDS
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Indian Standard

BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTRONIC AND ELECTRICAL ITEMS

PART XI SALT MIST TEST

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BASIC ENVIRONMENTAL TESTING PROCEDURES FOR ELECTRONIC AND ELECTRICAL ITEMS

PART XI SALT MIST TEST

0. FOREWORD

0.1 This Indian Standard (Part XI) was adopted by the Indian Standards Institution on 17 February 1983, after the draft finalized by the Environmental Testing Procedures Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 The differences in environmental testing procedures for component type and equipment type items are fast disappearing in the context of technological developments. It is, therefore, felt necessary to have uniform testing procedures wherever possible. This series of standards on environmental testing procedures (IS : 9000) has been prepared with this objective. This is also in line with the principle adopted by IEC/TC 50 'Environmental testing' in developing unified series of standards on environmental testing procedures by the International Electrotechnical Commission.

0.2.1 It is proposed to withdraw the existing Indian standards, namely, IS : 589-1961* and IS : 2106† series dealing with environmental tests for electronic components and equipment respectively, as soon as the tests mentioned therein are covered in the new series (IS : 9000).

0.3 This standard (Part XI) deals with the determination of the corrosive effects of salt atmospheres on electronic and electrical items.

0.4 In the preparation of this standard, assistance has been derived from the following publications:

IEC Pub 68-2-11 (1964) Test Ka: Salt mist. International Electrotechnical Commission (IEC).

IEC Document 50B (Central Office) 212 Draft — Revision of publication 68-2-11 Test Ka: Salt mist. International Electrotechnical Commission (IEC).

*Basic climatic and mechanical durability tests for components for electronic and electrical equipment (revised).

†Environmental tests for electronic and electrical equipment.

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IEC Document 50B (Secretariat) 234 Draft — Test Ka: Salt mist, cyclic (sodium chloride solution). International Electro-technical Commission (IEC).

JSS 50101-1972 Environmental test methods for service electronic components. Directorate of Standardization, Ministry of Defence, India.

JSS 55555-1977 Environmental test methods for electronic and electrical equipment. Directorate of Standardization, Ministry of Defence, India.

0.5 In reporting the result of a test made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

1. SCOPE

1.1 This standard (Part XI) gives details of test procedures for the application of salt mist test on electronic and electrical items as a part of basic environmental testing procedures.

NOTE — This test is not an all-purpose corrosion test.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions and explanation of terms given in IS : 9000 (Part I)-1977† shall apply.

3. OBJECT

3.1 The object of this test is to determine the suitability of electronic and electrical items when used or stored under salt laden atmospheres. This test is intended mainly for evaluating the quality and uniformity of protective coatings.

4. TEST CHAMBER

4.1 The chambers used for this test shall be as follows:

- a) For Procedure 1 — The chamber shall conform to the requirements of **4.2** to **4.9**.

*Rules for rounding off numerical values (revised).

†Basic environmental testing procedures for electronic and electrical items : Part I General.

- b) For Procedures 2 and 3 — A single chamber conforming to the requirements of 4.2 to 4.10 or a salt mist chamber conforming to the requirements of 4.2 to 4.9 and a humidity chamber conforming to the requirements of 4.10.

NOTE — Transfer of items to humidity chamber after the exposure to salt laden atmosphere is preferable in the interest of reproducible results in test conditions.

4.2 The chamber used for this test shall include an exposure chamber with racks for supporting the test items, salt solution reservoir with means for maintaining an adequate level of solution, means for atomization of the salt solution including suitable nozzles and compressed air supply, chamber-heating means and control and means for humidifying the air used for atomization at a temperature above the chamber test temperature.

4.3 The chamber and all its accessories shall be made of such materials that they themselves are not affected by the salt laden atmosphere or do not give rise to electrolytic corrosion when in contact with each other or the items under test.

4.4 The salt laden atmosphere shall freely circulate around the item under test. The chamber and all its accessories shall be so constructed and arranged that there is no direct impingement of the salt fog or dripping of the condensate on the item under test. The liquid which has come in contact with the item under test shall not be allowed to return to the salt solution reservoir.

4.5 The chamber shall be properly vented to prevent pressure build up inside the chamber. The discharge end of the vent shall be protected from strong draft which may create strong air currents inside the chamber.

4.6 The working space of the chamber where the test items are exposed for the test shall be capable of being maintained, if required, at a temperature of 35°C. Satisfactory methods for controlling the temperature accurately are by housing the chamber in a properly controlled constant-temperature room, by thoroughly insulating the chamber and preheating the air to the proper temperature prior to atomization or by jacketing the chamber and controlling the temperature of the water or air used in the jacket. The use of immersion heaters within the chamber for the purpose of maintaining the temperature within the exposure zone is prohibited.

4.7 The atomizers used shall be of such design and construction as to produce a finely divided, wet and dense fog. Atomizing nozzles shall be made of materials that are non-reactive to the salt solution.

NOTE 1 — Suitable atomization may be obtained in chambers having a volume of less than 0.34 cubic meters under the following conditions :

- a) Nozzle orifices between 0.51 mm and 0.76 mm in diameter,

- b) Atomization of approximately 10 litres of salt solution per m³ of chamber volume per 24 hours, and
- c) Nozzle pressure as low as practicable to produce the fog at the required rate.

NOTE 2 — When using large size chambers having a volume considerably in excess of 0.34 cubic meters, these conditions may require modification to meet the requirements for operating conditions.

4.8 The conditions maintained at all parts of the working space of the chamber shall be such that a clean fog-collecting receptacle placed at any point will collect from 0.5 to 3 ml of solution per hour for each 80 square centimetres of horizontal collecting area (10 cm diameter) based on an average test of at least 16 h. The receptacle shall be placed in such a manner that it is not shielded by test items and no drops of solution from test items and other sources are collected in it.

4.9 The compressed air entering the atomizer shall be essentially free from all impurities, such as oil and dirt. For this purpose, an air filter fabricated from a non-corrosive material shall be provided in the air supply line. A rolled glass wool cloth and a glass diaphragm shall be suitably placed in the filter. Means shall be provided to humidify and warm the compressed air as required to meet the operating conditions. To ensure against clogging the atomizers by salt deposition, the air should have a relative humidity of at least 85 percent at the point of release from the nozzle. A satisfactory method is to pass the air in very fine bubbles through a tower containing heated water which should be automatically maintained at a constant level. The temperature of the water should be at least 35°C. The permissible water temperature increases with increasing volume of air and with decreasing insulation of the chamber and the chamber's surroundings. However, the temperature should not exceed a value above which an excess of moisture is introduced into the chamber (for example, 43°C at an air pressure of 85 kPa or a value which makes it impossible to meet the requirements for operating temperature).

4.10 A suitable damp heat chamber shall be used for conditioning the items immediately after the exposure to the salt laden atmosphere as required in Procedures 2 and 3. The damp heat chamber shall be capable of maintaining its working space at a temperature of $35 \pm 3^\circ\text{C}$ and relative humidity of 90 to 95 percent during the entire period of storage of the item under test. This chamber shall also satisfy the requirements specified for the chamber in IS : 9002 (Part III)-1979*.

5. PRECONDITIONING

5.1 The item under test shall be given a minimum of handling, particularly on the significant surfaces, and shall be prepared for test

*Specification for equipment for environmental tests for electronic and electrical items : Part III Humidity chamber.

immediately before exposure. Unless otherwise specified, uncoated metallic or metallic coated items shall be thoroughly cleaned of oil, dirt and grease as necessary until surface is free from water break. The cleaning methods shall not include use of corrosive solvents or solvents which deposit either corrosive or protective films or the use of abrasives other than a paste of pure magnesium oxide. Items having an organic coating shall not be solvent cleaned. Those portions of the item which come in contact with the support and unless otherwise specified in the case of coated items, cut edges and surfaces not required to be coated, shall be protected with a suitable coating of wax or similar material impervious to moisture.

6. INITIAL MEASUREMENTS

6.1 The items shall be visually inspected and electrically and mechanically checked, as required by the relevant specification.

7. CONDITIONING

7.1 General

7.1.1 The item under test shall be subject to this test in its 'unpacked' and 'switched-off' condition. Three test procedures are specified for this test. Test Procedure 1 is applicable to component type items. Test Procedures 2 and 3 are applicable to equipment type items. Where an item is likely to be exposed to severe salt contamination conditions, Test Procedure 2 may be preferred and in less exacting conditions where a salt laden atmosphere will occasionally exist. Test Procedure 3 may be preferred. The relevant specification shall specify any of the three test procedures, as necessary.

7.2 Preparation of Salt Solution

7.2.1 For Procedure 1, the salt used shall be sodium chloride containing on dry basis not more than 0.1 percent sodium iodide and not more than 0.5 percent of total impurities. The salt solution used shall contain either 5 percent or 20 percent sodium chloride. The 5 percent solution shall be referred, unless the relevant specification specifies otherwise. The distilled water or demineralised water used for making the salt solution shall not contain more than 200 parts per million of total solids. The composition and characteristics of the salt solution shall be as stated in Table 1.

7.2.2 For Procedures 2 and 3, the salts given in 2 shall be dissolved in distilled/demineralised water for the preparation of the salt solution. The proportions of the ingredients in the solution are to be within 10 percent of those given in Table 2.

These quantities refer to the anhydrous version of the salts and shall be of laboratory reagent grade or similar purity. A sufficient quantity of the solution shall be made to suit the capacity of the chamber. The pH value shall be between 7.5 and 8.5, corrected to 20°C, and may need to be adjusted to this value, if necessary, by the addition of hydrochloric acid AR or sodium hydroxide AR, as appropriate.

TABLE 1 COMPOSITION OF SALT SOLUTION (PROCEDURE 1)

(Clause 7.2.1)

SL No.	REQUIREMENT	20 PERCENT SOLUTION	5 PERCENT SOLUTION
i)	Distilled water by weight	80 parts	95 parts
ii)	Sodium chloride by weight*	20 parts	5 parts
iii)	Specific gravity	1.126 to 1.157	1.026 8 to 1.041 3
iv)	pH† (35 ± 1°C)	6.5 to 7.2	6.5 to 7.2

*Tolerance ±10 percent.

†Only chemically pure grade hydrochloride acid or sodium hydroxide shall be used to adjust the pH.

TABLE 2 COMPOSITION OF SALT SOLUTION (PROCEDURES 2 AND 3)

(Clause 7.2.2)

SL No.	INGREDIENT	QUANTITY PER 1 LITRE OF SOLUTION
i)	Sodium chloride (Na Cl)	26.5 g
ii)	Magnesium chloride (MgCl ₂)	2.4 g
iii)	Magnesium sulphate (MgSO ₄)	3.3 g
iv)	Calcium chloride (CaCl ₂)	1.1 g
v)	Potassium chloride (KCl)	0.73 g
vi)	Sodium bicarbonate (NaHCO ₃)	0.20 g
vii)	Sodium bromide (NaBr)	0.28 g
viii)	Distilled water	To make up 1 litre of solution

7.3 Procedure 1

7.3.1 Unless otherwise specified, the items shall be supported in the chamber in such a position that their significant surfaces are approximately 15° from the vertical. Wherever practicable, the items shall be supported from the bottom or from the sides. When the items are suspended from the top, the suspension shall be by means of hooks made of glass or

plastic materials non-reactive to salt solution. The items shall not shield one another from freely settling salt fog and corrosion products. Condensate of one item shall not fall on the other.

7.3.2 The items shall be exposed to a continuous salt laden atmosphere in the chamber for a period of 48 h, unless 96 h of exposure is specified in the relevant specification.

7.3.3 The composition of the salt solution shall be as specified in **7.2.1**.

7.3.4 During the entire period of exposure as specified in **7.3.2**, the temperature of the chamber shall be maintained at $35 \pm 3^{\circ}\text{C}$.

7.4 Procedure 2

7.4.1 The item under test shall be positioned in the chamber in its normal operational attitude at the laboratory atmospheric conditions.

7.4.2 The item shall be exposed to a continuous salt laden atmosphere in the chamber for a period of 2 h under the laboratory temperature. The quantity of salt solution sprayed shall be approximately 10 litres per m^3 of chamber volume per 24 hours.

7.4.3 The composition of the salt solution shall be as specified in **7.2.2**.

7.4.4 At the end of the period specified in **7.4.2**, the item shall be removed from the chamber and transferred to a damp heat chamber maintained at a temperature of $35 \pm 3^{\circ}\text{C}$ and relative humidity of 90 to 95 percent and stored under these conditions for a period of 7 days.

7.4.5 The procedure specified in **7.4.2** to **7.4.4** constitutes one cycle. The item shall be subjected to a total of 4 consecutive cycles.

7.5 Procedure 3

7.5.1 The item under test shall be positioned in the chamber in its normal operational attitude at the laboratory atmospheric conditions.

7.5.2 The item shall be exposed to a continuous salt laden atmosphere in the chamber for a period of 2 hours under the laboratory temperature. The quantity of salt solution sprayed shall be approximately 10 litres per m^3 of chamber volume per 24 hours.

7.5.3 The composition of the salt solution shall be as specified in **7.2.2**.

7.5.4 At the end of the period specified in **7.5.2**, the item shall be removed from the chamber and transferred to a damp heat chamber maintained at a temperature of $35 \pm 3^{\circ}\text{C}$ and relative humidity of 90 to 95 percent and stored under these conditions for a period of 22 hours.

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7.5.5 The procedure specified in **7.5.2** to **7.5.4** constitutes one cycle. The item shall be subjected to a total of 3 consecutive cycles.

7.6 Visual Examination

7.6.1 For Procedure 1, at the end of the conditioning period specified in **7.3.2**, the items shall be removed from the chamber and examined for corrosion and deterioration of metal parts, finishes, materials, etc. To aid in examination, if necessary, the items may be given a gentle wash in running water not warmer than 38°C with light brushing using a soft hair brush or plastic bristle brush to remove the salt deposits. The surplus water shall be removed by shaking.

7.6.2 For Procedures 2 and 3, at the end of the conditioning period specified in **7.4.5** and **7.5.5**, the items, unless otherwise specified by the relevant specification, shall be washed in running tap water for five minutes, rinsed in distilled water or demineralized water and then shaken by hand or subjected to an airblast to remove droplets of water, then dried for one hour at $55 \pm 2^\circ\text{C}$ and allowed to cool under recovery conditions for not less than 1 hour nor more than 2 hours. The relevant specification shall specify, if required, other methods to be used for washing and drying. The items shall be stored under recovery conditions for not less than one hour and not more than 2 hours. The temperature of the water used for washing shall not exceed 35°C.

8. RECOVERY

8.1 The items shall then be subjected to recovery under standard atmospheric conditions for testing for a period of 2 to 4 hours, unless otherwise specified in the relevant specification.

9. FINAL MEASUREMENTS

9.1 The items shall then be visually inspected and electrically and mechanically checked, as required by the relevant specification.

10. INFORMATION TO BE GIVEN IN THE RELEVANT SPECIFICATION

10.1 When this test is included in the relevant specification, the following details shall be given as far as they are applicable:

	<i>Clause Ref</i>
a) Preconditioning	5
b) Initial measurements	6
c) Applicable test procedure	7.1.1
d) Concentration of salt solution, if other than 5 percent (for Procedure 1)	7.2.1

	<i>Clause Ref</i>
e) Method of supporting of test items, if other than that specified (for Procedure 1)	7.3.1
f) Period of exposure, if other than 48 h (for Procedure 1)	7.3.2
g) Period of recovery, if other than 2 to 4 h	8.1
h) Final measurements	9
j) Any deviation from the normal test procedure	—

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